Exercise 1: [5 marks] (<u>Fill in the answer sheet in page 7</u>)

1. **To solve any problem through OR approach the first step is**
   a. understand the problem.
   b. define the problem.
   c. formulate a mathematical model.
   d. None of the above
2. **The step of testing the model is referred to as**
   a. model implementation.
   b. model application.
   c. model formulation.
   d. model validation
3. **The assumption that each decision variable in every equation must appear with a constant coefficient is referred to as**
   a. proportionality.
   b. additivity.
   c. certainty.
   d. divisibility.
4. **If the divisibility assumption cannot be assumed to hold, the problem would call for**
   a. a nonlinear programming solution approach.
   b. a linear programming solution approach.
   c. an integer programming solution approach.
   d. None of the above
5. **The linear programming assumption called certainty means that**
   a. the problem is assumed to have no probabilistic elements whatsoever.
   b. decision variables can take on fractional values.
   c. decision variables are added or subtracted together, never multiplied or divided by each other.
   d. each decision variable in every equation must appear with a constant coefficient.
6. **The optimum value occurs anywhere in feasible region.**
   a. True b. False
7. **In linear programming approach both objective function and constraints are expressed in linear forms.**
   a. True b. False
8. **A basic solution is said to be a feasible solution if it satisfies all constraints.**
   a. True b. False
9. **The quantifiable decisions to be made are represented as constraints.**
   a. True b. False
10. **An optimal solution is a solution that has the most favorable value of the objective function.**
    a. True b. False

Exercise 2: [18 marks]

Maximize $Z = 10x_1 + 12x_2$

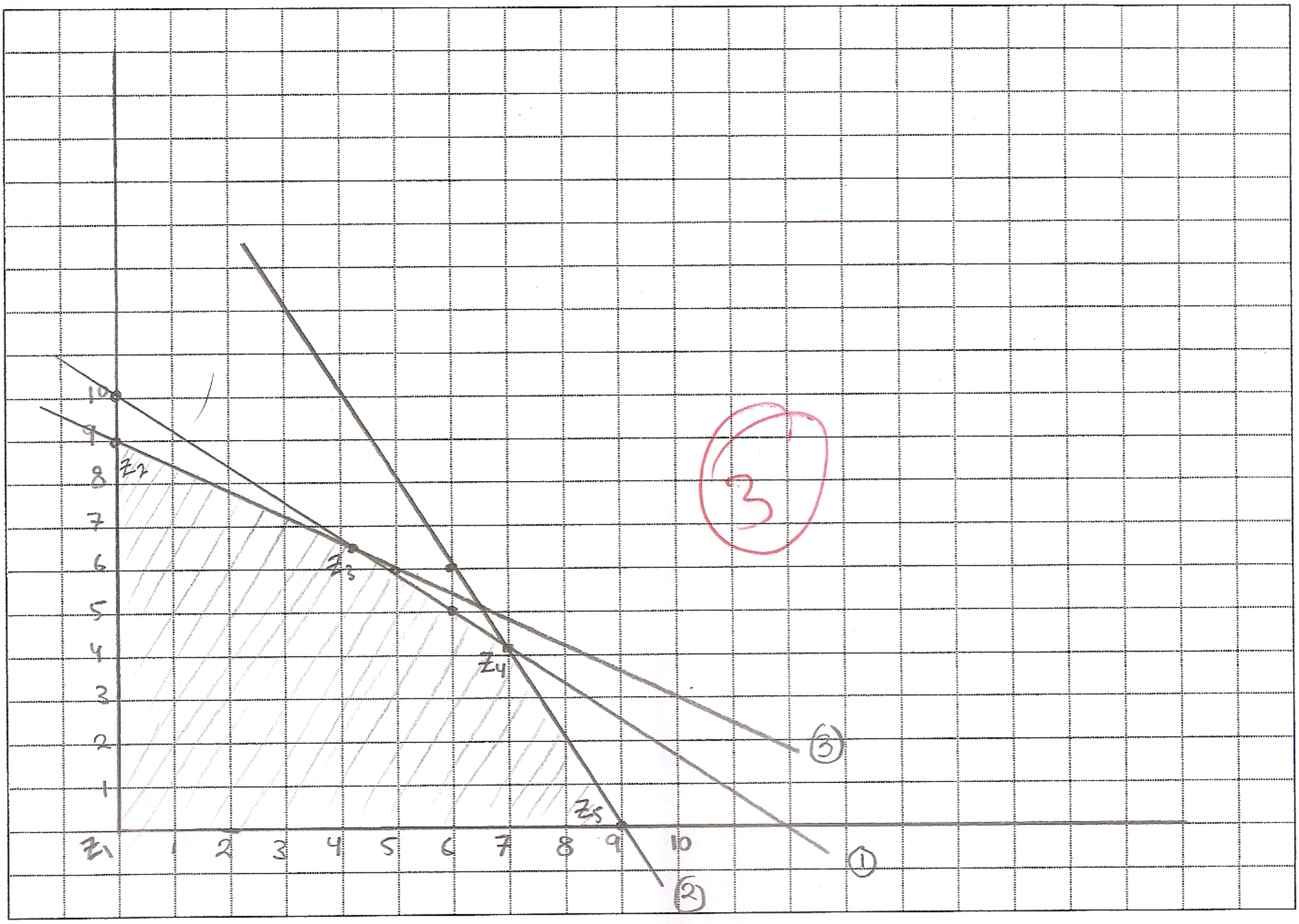
subject to

$$5x_1 + 6x_2 \le 60$$
$$8x_1 + 4x_2 \le 72$$
$$3x_1 + 5x_2 \le 45$$

and $x_1 \ge 0,\ x_2 \ge 0$

Use the graphical method to find **all the optimal solutions** for the above problem.

NB: <u>Identify the optimal solution and all adjacent corner point feasible solutions of the optimal solution</u>.



As we cannot draw a graph for inequalities let us consider them as equations &

Max $Z = 10x_1 + 12x_2$

① $5x_1 + 6x_2 = 60$ $\quad P_1 (6, 5)$ $\quad P_2 (0, 10)$

② $8x_1 + 4x_2 = 72$ $\quad P_1 (9, 0)$ $\quad P_2 (6, 6)$

③ $3x_1 + 5x_2 = 45$ $\quad P_1 (0, 9)$ $\quad P_2 (5, 6)$

Z_1 (0, 0) = 10(0) + 12(0) = 0 feasible solution 2
Z_2 (0, 9) = 10(0) + 12(9) = 108 feasible solution 2
Z_3 (4.28, 6.43) = 10(4.28) + 12(6.43) = 119.96 optimal solution 1 1
Z_4 (6.86, 4.28) = 10(6.86) + 12(4.28) = 119.96 optimal solution 2 1
Z_5 (9, 0) = 10(9) + 12(0) = 90 feasible solution 2

Z_3 is the intersection of line ① & ③

$*(3)$ ① $5x_1 + 6x_2 = 60$
$*(-5)$ ③ $3x_1 + 5x_2 = 45$ ⇝

$$\cancel{15x_1} + 18x_2 = 180$$
$$\cancel{-15x_1} - 35x_2 = -225$$
$$\frac{-7x_2}{-7} = \frac{-45}{-7}$$
$$x_2 = 6.43$$

2
1.0

Subsinute in equation ③ to find x_1
$3x_1 + 5(6.43) = 45$
$3x_1 = 45 - 32.15$
$x_1 = 12.85 / 3 = 4.28$

Z_4 is the intersection of line ① & ②

① $5x_1 + 6x_2 = 60$
$*(-1.5)$ ② $8x_1 + 4x_2 = 72$ ⇝

$$5x_1 + \cancel{6x_2} = 60$$
$$-12x_1 - \cancel{6x_2} = -108$$
$$\frac{-7x_1}{-7} = \frac{-48}{-7}$$
$$x_1 = 6.86$$

2
1.0

subsitute in equation ① to find x_2
$5(6.86) + 6x_2 = 60$
$6x_2 = 60 - 34.3$
$x_2 = 25.7 / 6 = 4.28$

the optimal solution for this problem is in point Z_3 & Z_4, where x equal 4.28, y equal 6.43. And when x equal 6.86, y equal 4.28

2
4

Exercise 3: [17 marks]

A manufacturing company can make two types of products: Product1 and Product2. Each of the products requires time on a cutting machine and a finishing machine. Relevant data are:

	Products	
	Type1 x	Type2 y
✓Cutting hours (per unit)	2	1	≤ 390
✓Finishing hours (per unit)	3	3	≤ 810
✓Unit cost	(-) 28	(-) 25
Selling price	34	29
✓Maximum sales (units per week)	200 6	4 200

The number of cutting hours available per week is 390 and the number of finishing hours available per week is 810.

Question: Formulate a linear programming model for this problem. (**NB: don't solve it**)

NB: **Show all the details of your answer.**

Let x be the number of units of product 1 2

Let y be the number of units of product 2 2

objective function for the problem is to maximize profit

~~$(\text{Min } Z = 28x + 25y)$~~ ✗

$\text{Max } Z = 6x + 4y$ 3

profit = Selling price - Unit cost

Type 1 = 34 - 28 = 6

Type 2 = 29 - 25 = 4

functional Constraints

* We are limited by the number of cutting hours per week

$2x + y \leq 390$ 2

* We are limited by the number of finishing hours per week

$3x + 3y \leq 810$ 2

* We are limited by number of unit can be saled per week

$x \leq 200$ 2

$y \leq 200$ 2

$x \geq 0, y \geq 0$ 2

Answer Sheet for M/C and True/False questions
Circle the correct answer

1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B		
7	A	B		
8	A	B		
9	A	B		
10	A	B		